# Space Weather Technical Forecast

Issued on Saturday, 05 November 2022 at 12:08 Local

**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

**Space Weather Forecast Headline: Slight chance G1/minor storms days 3 and 4 (7 and 8 Nov). Active fluence (1e8 integrated pfu) likely through much of the period.**

## Analysis of Space Weather Activity over past 24 hours

**Solar Activity:** Solar activity has been Low through the last 24 hours, with a few low levels C-class flares observed in the past 24 hour period. There are eight active regions, which are mainly covering the northern hemisphere. Much of the recent development in sunspot regions has been from four regions in the northeast quadrant, and one of these (AR3137) is displaying a Beta-Gamma configuration. The two large regions in the northwest quadrant, AR3131 and AR3135 appear to be stable. A remaining region in the southwest is weak and simple. No significant Earth-directed CMEs have been identified in recent imagery.

**Solar Wind / Geomagnetic Activity:** The solar wind, observed by DSCOVR at L1, is showing an ongoing but declining influence from coronal hole 39 with speeds declining from 550km/s to 500km/s. Density was just above average, with a declining trend to average levels. Total magnetic field strength, IMF, has been weak with a declining trend. The north-south component, Bz has varied weakly, with a mostly negative bias noted. Phi angle has been positive (away from the Sun) through the period. Geomagnetic activity was quiet to unsettled throughout (Kp2-3).

**Energetic Particles / Solar Radiation:** The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has remained at background levels. High energy electron flux (greater than 2 MeV) at GOES-16 has remained at high levels, reaching a peak of 5.87e3 pfu at 04/1815UTC. Electron fluence levels have steadily risen to reach 2.1e8 integrated pfu at 05/0000 UTC, with further rises in the past 12 hours.

## Four-Day Space Weather Forecast Summary

**Solar Activity:** Solar activity is forecast to be mainly Low, with a slight but probably increasing chance of Moderate activity due to developing regions on the visible disc. There also remains a risk from further regions rotating onto the disc from the farside of the Sun.

**Solar Wind / Geomagnetic Activity:** No Earth directed CMEs are forecast. The high speed stream from coronal hole 39 is expected to decline to slow-ambient levels by the end of day 2 (6 Nov). Coronal hole 42 may then connect with the Earth either later on day 3 (7 Nov) or during day 4 (8 Nov), although there is low confidence in the strength of any connection. Geomagnetic activity is expected to be mainly Quiet to Unsettled, but there is a slight chance of Active or G1/Minor Storm intervals late on day 3 or during day 4 (7 and 8 Nov).

**Energetic Particles / Solar Radiation:** The high energy proton flux (greater than 10 MeV) observed by GOES-16 is expected to be at background levels. High energy electron flux (greater than 2MeV) is expected to remain mainly above the high threshold through much of the period, with a declining trend and brief sharper drops and recoveries due to the diurnal orbital cycle.

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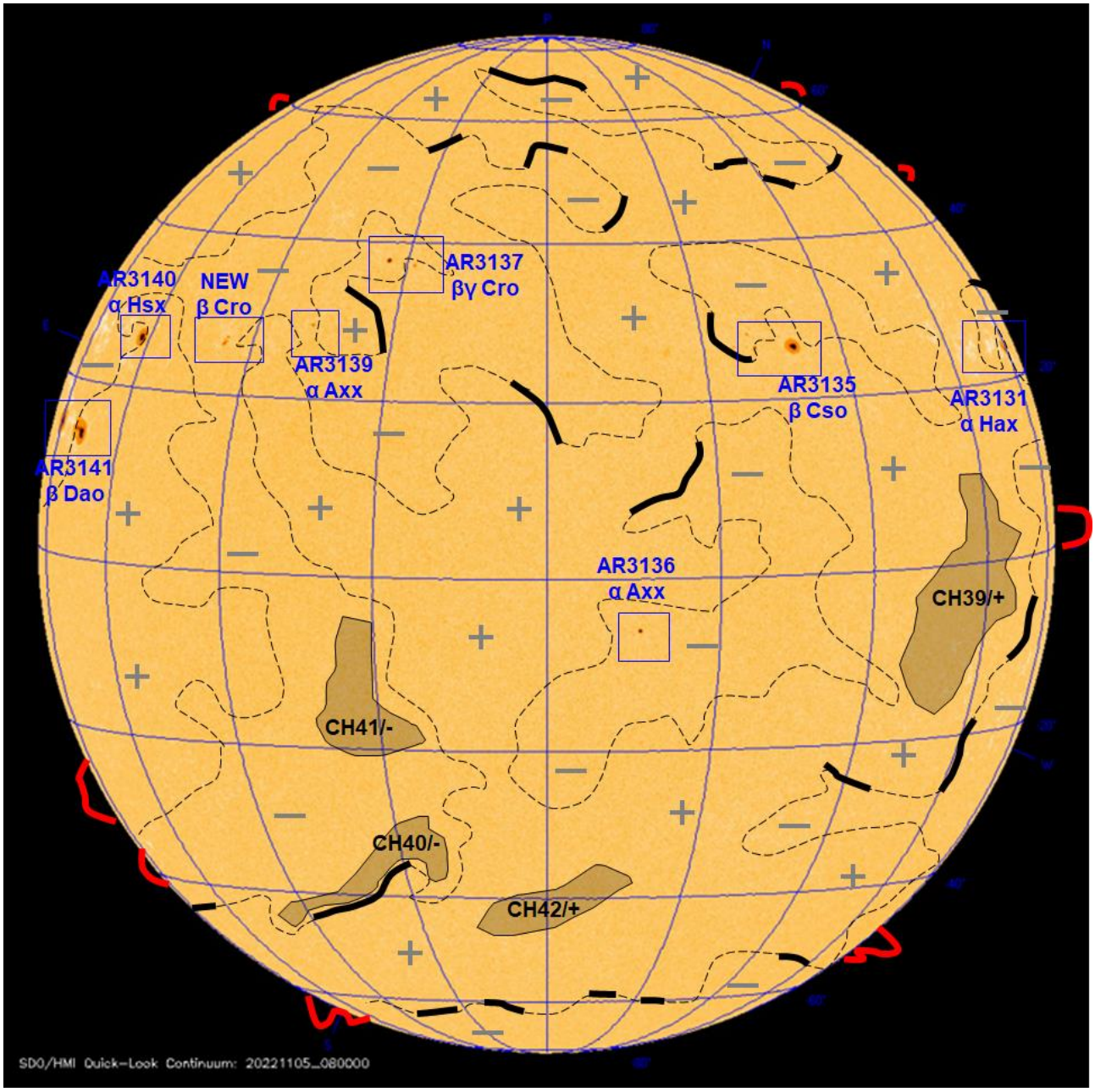
Electron fluence values are expected to remain above the Active (1e8 integrated pfu) threshold through the period due to elevated electron flux values.

**Figure 1. Solar Analysis Valid 0800 UTC, 5 November 2022.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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## Geomagnetic Storms:

No Earth-directed CMEs are forecast.

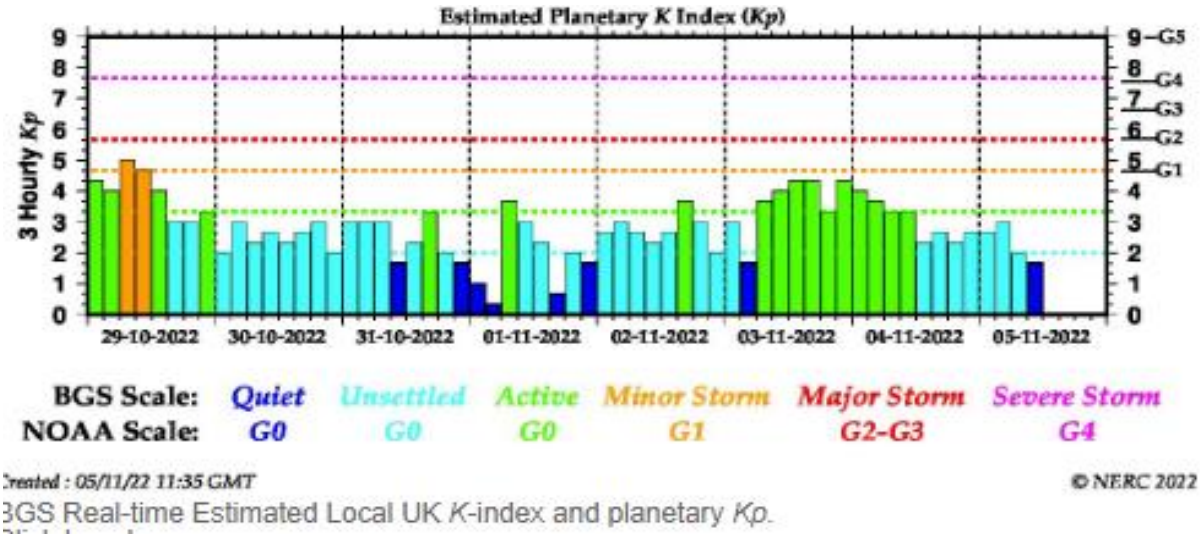
Earth remains within the influence of a high speed stream (HSS) from coronal hole 39, with solar winds declining from elevated levels around 500 km/s and are forecast to reach slow-ambient levels or around 400 km/s by day 2 (6 Nov). Coronal hole 42, in the southern hemisphere is forecast to connect with the Earth either late on day 3 (7 Nov) or during day 4 (8 Nov), with a related HSS enhancing solar winds to reach around 500km/s once more, however confidence is low given the southerly location of this originating feature..
Geomagnetic activity is expected to be mainly Quiet to Unsettled, with a slight risk of Active during days 1 and 2 (5 and 6 Nov). Little change is forecast thereafter with mostly Quiet to Unsettled conditions during days 3 and 4 (7 and 8 Nov). There is a slight chance of Active intervals or G1 conditions later on day 3 (7 Nov) or during day 4 (8 Nov) as the next coronal hole HSS connects with the Earth, again with low confidence.

| Geo-Magnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 1 | 1 | 10 | 10 |
| Strong | G3 | No | 1 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

## Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil

**Figure 2: BGS Magnetometer data (below) showing mainly Quiet to Unsettled levels in past 24 hours.**


Estimated Planetary K Index (Kp)
3 Hourly Kp
9 8 7 6 5 4 3 2 1 0
G5 G4 G3 G2 G1
29-10-2022 30-10-2022 31-10-2022 01-11-2022 02-11-2022 03-11-2022 04-11-2022 05-11-2022
BGS Scale: Quiet Unsettled Active Minor Storm Major Storm Severe Storm
NOAA Scale: G0 G0 G0 G1 G2-G3 G4
Created : 05/11/22 11:35 GMT
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BGS Real-time Estimated Local UK *K*-index and planetary *Kp*.

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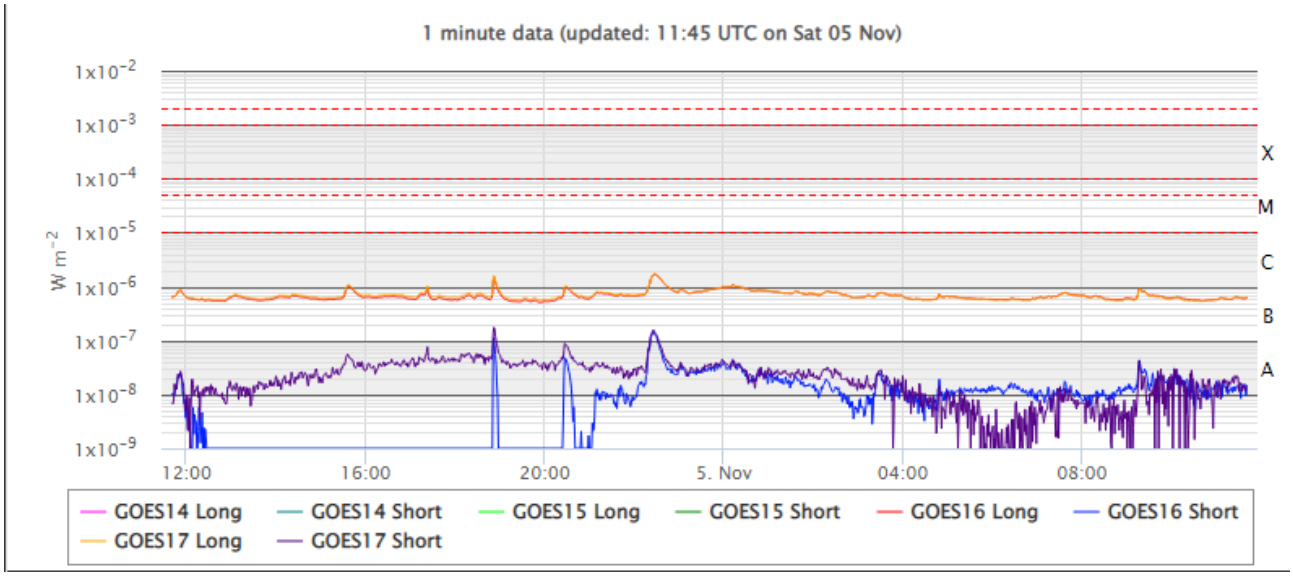
**Radio Blackouts - X-Ray Flares:**
There are eight sunspot regions on the visible disc, with the two most prominent regions being two relatively mature and generally inactive regions in the northeastern quadrant. The most notable development has been from AR3141 very close to the limb, with two large spots as part of an increasingly complex bipolar region. Far side imagery indicates that further complex regions could rotate onto the visible disc through the next four days. Solar activity is forecast to be mainly Low, with a continuing slight chance (15%) for solar activity to reach Moderate levels, especially from the regions which are on the northeast quadrant. In fact the previous M-class flare was observed on 14 October.

| X Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability | | | (%) | (%) | (%) | (%) |
| Active | R1-R2 M Class | No | 15 | 15 | 15 | 15 |
| Very Active | R3 to R5 X Class | No | 1 | 1 | 1 | 1 |

**Figure 3: X-ray flux plot at GEO from GOES satellites showing Low solar activity in past 24 hours.**

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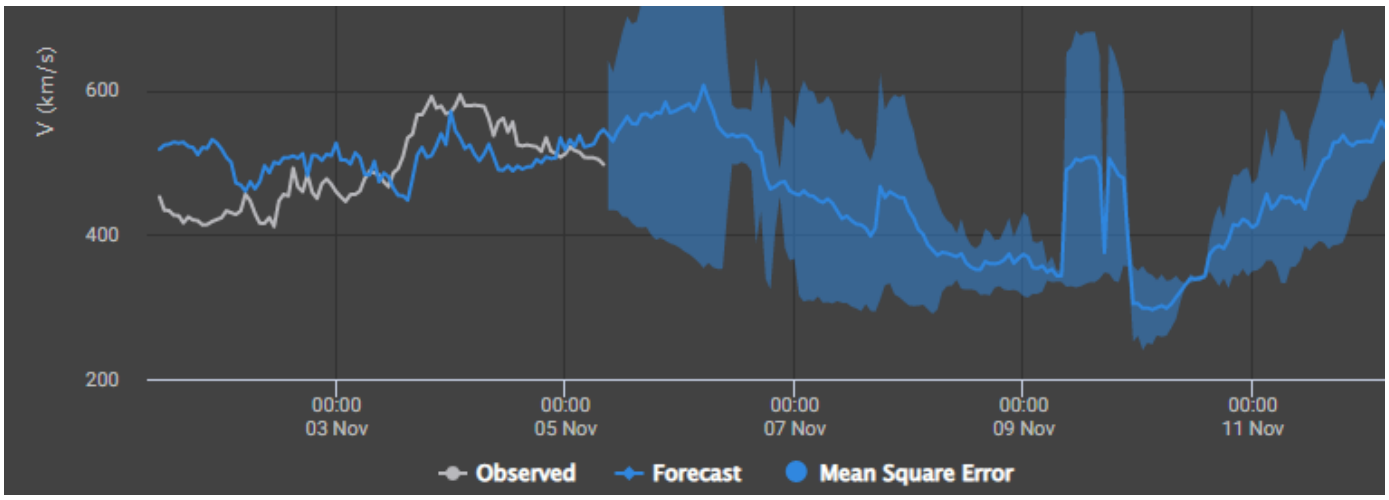
**Solar Radiation Storms - (High Energy Protons):**
The high energy proton flux (greater than 10 MeV) at GEO, observed by GOES-16 is currently at background levels and is forecast to remain at this level through the guidance period.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Active | ≥ S1 | No | 1 | 1 | 1 | 1 |
| Very Active | ≥ S3 * | No | 1 | 1 | 1 | 1 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

**Figure 4: Met Office Solar Winds Prediction Model (SWPM)**

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## High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) has remained at high levels over the past 24 hours with this likely to continue as a result of the recent input into the radiation belts. This is only likely to decrease slowly through the next four days, with no significant geomagnetic activity expected. Brief declines are possible due to diurnal variations, but these are unlikely to be sustained.

Electron fluence has risen sharply in response to the increase flux and is expected to remain above the Active threshold (1e8 integrated pfu) for much of the period. The risk is considered lower towards the end of the period simply due to reduced confidence in any geomagnetic activity and rate of electron losses in the radiation belts.

| GEO Electron Environment<br>Probability (Exceedance) | Level ($cm^{-2}\ sr^{-1}\ day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC)<br>(%) | Day 2 (00-24 UTC)<br>(%) | Day 3 (00-24 UTC)<br>(%) | Day 4 (00-24 UTC)<br>(%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ 2 MeV ≥ $1x10^8$** | Yes | 100 | 90 | 80 | 70 |
| **Very Active** | **≥ 2 MeV ≥ $1x10^9$** | No | 1 | 1 | 5 | 5 |

**Figure 5: High energy electron flux and Met Office REFM output showing active levels.**

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